

Intervention Analysis in Seasonal Adjustment

In some Consumer Price Index (CPI) series, a process known as seasonal adjustment is used to identify and factor out seasonal movements. The resulting seasonally adjusted data reflect an estimate of nonseasonal price movements. The CPI uses the Bureau of the Census X-12-ARIMA software to calculate factors for seasonal adjustment of both historical and current series.

Seasonal adjustment for some CPI series use a technique called intervention analysis that is included in the Census X-12 seasonal adjustment program. Intervention analysis seasonal adjustment allows economic phenomena that are not seasonal in nature, such as outliers and level shifts, to be factored out of indexes before calculation of seasonal adjustment factors. (An *outlier* is an extreme value for a particular month. A *level shift* is a change or shift in the price level of a CPI series caused by an event, such as a sales tax increase or oil embargo, occurring over one or several months.) The result is an adjustment based on a representation of the series with the seasonal pattern emphasized. Intervention analysis seasonal adjustment also makes it possible to account for seasonal shifts, resulting in a better seasonal adjustment in the periods before and after the shift occurred. For those CPI series adjusted using intervention analysis seasonal adjustment techniques, the resulting seasonal factors more accurately represent the underlying seasonal pattern. Seasonal factors are applied to the original unadjusted series without intervention. As a result, level shifts and outliers, removed for the calculation of seasonal factors, are present in the seasonally adjusted series.

When X-12-ARIMA is used to perform intervention analysis seasonal adjustment, unusual events are modeled as part of the seasonal adjustment process. X-12-ARIMA's built-in regression variables are used for directly estimating the effects of sudden level changes and other disruptions and removing those effects before calculation of the seasonal factors. For a comprehensive discussion of X-12-ARIMA and intervention analysis seasonal adjustment, see "Improvements to CPI Procedures for Intervention Analysis Seasonal Adjustment" in the December 1996 issue of the [CPI Detailed Report](#).

A CPI series may receive intervention analysis seasonal adjustment (IASA) if the series is directly adjusted and has a relative importance greater than 0.5% to the U.S. city average all items index. If IASA is used for a component of the seasonally adjusted U.S. city average all items index, series which are subsets of the component series are also eligible for IASA. In January 2009, BLS adjusted the series listed below using intervention analysis seasonal adjustment techniques. BLS examined these series using the 8-year span from January 2001 through December 2008.

| | | |
|--|---|--|
| Airline fare | Ice cream and related products | Nondurables less food and apparel |
| Beverage materials including coffee and tea | Juices and nonalcoholic drinks | Nondurables less food and beverages |
| Cable and satellite television and radio service | Leased cars and trucks | Nondurables less food, beverages, and apparel |
| Carbonated drinks | Motor fuel | Other lodging away from home including hotels and motels |
| Coffee | New cars | Public transportation |
| Electricity | New cars and trucks | Utilities and public transportation |
| Gasoline, all types | New trucks | Utility (piped) gas service |
| Gasoline, unleaded midgrade | New vehicles | Video and audio |
| Gasoline, unleaded premium | Nonalcoholic beverages and beverage materials | |
| Gasoline, unleaded regular | Nondurables | |
| | Nondurables less food | |

For each series that was adjusted using X-12-ARIMA intervention analysis seasonal adjustment, a list of level shifts is provided in the table below, along with the identified causes (events). Outliers are also included in the list.

For further information, write to the Bureau of Labor Statistics, Division of Consumer Prices and Price Indexes, 2 Massachusetts Avenue, NE, Room 3615, Washington, DC 20212-0001, or call Jeff Wilson at (202) 691-6968. Mr. Wilson may also be reached at Wilson.Jeff@bls.gov by e-mail.

Consumer Price Index series – intervention analysis seasonal adjustment

| Series | Level shift period(s) | Event | Outliers |
|--|-----------------------|---|------------------------|
| Airline fare | 4/08-7/08 | Higher fuel surcharges implemented by airlines due to increased fuel costs | None |
| | 7/08-12/08 | Return to normal pricing | |
| Beverage materials including coffee and tea | 11/04-4/05 | Smaller Brazilian coffee crop, rising Brazilian currency | 2/08 |
| Cable and satellite television and radio service | None | None | 6/05, 8/05 |
| Carbonated drinks | 4/02-6/02 | Promotions associated with significant new brand introductions | 8/01, 7/03, 3/07, 4/08 |
| | 8/08-10/08 | Higher commodity costs combined with a declining demand for soft drinks | |
| Coffee | 11/04-4/05 | Smaller Brazilian coffee crop, rising Brazilian currency | None |
| | 4/08 | Speculation of a smaller Brazilian crop, and a weak U.S. dollar | |
| Electricity | 6/01 | Increasing demand due to warmer than expected weather and raising rates to aid the conservation of supplies | 11/05 |
| | 1/06 | Larger than normal increase due to recovery from Hurricane Katrina | |
| Gasoline, all types | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Gasoline, unleaded midgrade | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|--------------------------------|-----------------------|---|-------------------------|
| Gasoline, unleaded premium | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Gasoline, unleaded regular | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Ice cream and related products | 5/01-7/01 | Early year drop in milk production was slow to recover. Demand for dairy products remained strong. | 11/03, 6/05, 8/06 |
| | 3/03-6/03 | Sluggish demand for dairy food "treats" | |
| Juices and nonalcoholic drinks | 4/02-6/02 | Promotions associated with significant new brand introductions | 7/03, 11/03, 3/07, 4/08 |
| | 2/05-4/05 | Orange juice futures increased due to cuts in projected citrus production of Florida, related to the previous hurricane season | |
| | 8/08-10/08 | Higher commodity costs combined with a declining demand for soft drinks | |
| Leased cars and trucks | 7/05-9/05 | Effect of interest rates rising to a four year high, which impacted the money factor included in leases | None |
| | 7/08-10/08 | Decreased demand for SUVs and light trucks due to higher gasoline prices, leading to lower residual prices and higher lease prices | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|---------------------|-----------------------|--|--|
| Motor fuel | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| New cars | 6/04-8/04 | Effect of very large cash incentives offered by domestic automakers | 11/01, 12/01, 1/02, 1/03, 2/03, 8/03, 8/07, 7/08, 8/08, 9/08 |
| | 11/04 | Return to normal promotions, combined with the effect of a model changeover | |
| | 6/05-8/05 | Employee pricing discounts offered by domestic automakers and corresponding incentives offered by imported makes | |
| | 8/05-10/05 | Short supply of fuel-efficient vehicles in light of record gasoline prices, combined with early 2006 model changeovers and a return to normal promotions following employee pricing offers | |
| New cars and trucks | 6/04-8/04 | Effect of very large cash incentives offered by domestic automakers | 11/01, 12/01, 1/02, 1/03, 2/03 |
| | 11/04 | Return to normal promotions, combined with the effect of a model changeover | |
| | 6/05-8/05 | Employee pricing discounts offered by domestic automakers and corresponding incentives offered by imported makes | |
| | 8/05-10/05 | Short supply of fuel-efficient vehicles in light of record gasoline prices, combined with early 2006 model changeovers and a return to normal promotions following employee pricing offers | |
| | 7/08-9/08 | Record discounting on vehicles in response to weaker sales and declining economic conditions | |
| New trucks | 6/04-8/04 | Effect of very large cash incentives offered by domestic automakers | 10/01, 11/01, 12/01, 1/02, 1/03, 2/03, 10/06 |
| | 11/04 | Return to normal promotions, combined with the effect of a model changeover | |
| | 6/05-8/05 | Employee pricing discounts offered by domestic automakers and corresponding incentives offered by imported makes | |
| | 8/05-10/05 | Return to normal pricing following employee pricing offers | |
| | 7/08-9/08 | Record discounting on vehicles in response to weaker sales and declining economic conditions | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|---|-----------------------|--|-------------------------------|
| New vehicles | 6/04-8/04 | Effect of very large cash incentives offered by domestic automakers | 11/01 12/01, 1/02, 1/03, 2/03 |
| | 11/04 | Return to normal promotions, combined with the effect of a model changeover | |
| | 6/05-8/05 | Employee pricing discounts offered by domestic automakers and corresponding incentives offered by imported makes | |
| | 8/05-10/05 | Short supply of fuel-efficient vehicles in light of record gasoline prices, combined with early 2006 model changeovers and a return to normal promotions following employee pricing offers | |
| | 7/08-9/08 | Record discounting on vehicles in response to weaker sales and declining economic conditions | |
| Nonalcoholic beverages and beverage materials | 4/02-6/02 | Promotions associated with significant new brand introductions in carbonated drinks | 7/03, 11/03, 3/07, 4/08 |
| | 2/05-4/05 | Orange juice futures increased due to cuts in projected citrus production of Florida, related to the previous hurricane season, combined with a small Brazilian coffee crop | |
| | 8/08-10/08 | Higher commodity costs combined with a declining demand for soft drinks | |
| Nondurables | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Nondurables less food | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|--|-----------------------|---|----------|
| Nondurables less food and apparel | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Nondurables less food and beverages | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Nondurables less food, beverages, and apparel | 3/03-5/03 | Oil strike in Venezuela ends, with faster than expected increases in oil supply | None |
| | 6/05-9/05 | Damage to U.S. oil refineries resulting from Hurricane Katrina, along with record global petroleum demand and continued political unrest in Iraq, Venezuela and Nigeria | |
| | 10/05-11/05 | Recovery of domestic oil refineries in the Gulf of Mexico, combined with easing crude oil prices | |
| | 8/06-10/06 | Collapse in profit margins for oil refineries | |
| | 9/08-12/08 | Response in crude oil markets to world-wide economic downturn | |
| Other lodging away from home including hotels and motels | 5/03 | Higher room rates resulting from sustained increases in occupancy | 9/05 |
| | 3/05 | Favorable skiing conditions on the east coast which lengthened the skiing season and extended the applicability of peak rates; increased demand related to conventions | |
| Public transportation | 2/08-7/08 | Higher fuel surcharges implemented by airlines due to increased fuel costs | None |
| | 7/08-12/08 | Return to normal pricing | |

CPI series – intervention analysis seasonal adjustment-continued

| Series | Level shift period(s) | Event | Outliers |
|-------------------------------------|-----------------------|--|-------------------|
| Utilities and public transportation | 1/03-3/03 | Supply problems in Venezuela, onset of colder than expected weather, and historically low storage levels | None |
| | 8/05-10/05 | Supply disruptions due to Hurricane Katrina | |
| | 1/06 | Larger than normal increase due to recovery from Hurricane Katrina | |
| | 4/08-7/08 | Effect of a widening storage deficit, combined with strong summer demand | |
| | 8/08-11/08 | Introduction of lower winter gas rates, and recovery of storage inventories | |
| Utility (piped) gas service | 1/03-3/03 | Supply problems in Venezuela, onset of colder than expected weather, and historically low storage levels | 10/06 |
| | 8/05-10/05 | Supply disruptions due to Hurricane Katrina | |
| | 3/08-7/08 | Effect of a widening storage deficit, combined with strong summer demand | |
| | 8/08-11/08 | Introduction of lower winter gas rates, and recovery of storage inventories | |
| Video and audio | None | None | 12/02, 6/05, 8/05 |